

PREHOSPITAL MEDICINE

Emergency ambulances on the public highway linked with inconvenience and potential danger to road users

G Saunders, A Gough

Emerg Med J 2003;**20**:277–280

See end of article for authors' affiliations

Correspondence to:
G Saunders, Staffordshire
Ambulance Service NHS
Trust, 70 Stone Road,
Stafford ST16 2TQ, UK;
Norton@
cannock3.freemove.co.uk

Accepted for publication
3 April 2002

Objectives: The main aim was to survey interactions between the public highway users and emergency ambulances using lights and sirens. The objectives were to identify negative and positive experiences, and to assess the frequency and consequences of these events.

Methods: Because of a poor response from a random postal pilot, a quota sample of 200 was adopted with a response of 65%. This provided data on demographics, details of previous interactions, and possible third party effects. Participant perception of psychological stress in negative interactions was also recorded. Possible links between the recorded interactions were assessed using the χ^2 tests of association.

Results: The passage of an emergency ambulance using lights and sirens caused the public to move from their chosen position in most cases (61%). Horns or sirens were used frequently (86%), but they were not always applied in unison with the warning lights. A significant association was found between the satisfactory handling of events by the ambulance crews and the use of audible warning devices ($p < 0.001$). Twenty per cent of avoidance manoeuvres necessitated reversing, which was associated with a third party affect ($p < 0.005$). Roughly one third of the participants found interactions stressful and felt that the events could have been avoided. Most public road users (91%) believed that they acted in a controlled manner.

Conclusions: The findings suggest that most participants had interacted with the emergency ambulances in a positive manner, while a smaller but significant fraction of the public road users found the interactions difficult to handle. A third party effect was identified in avoidance manoeuvres. Further longitudinal research with random sampling is recommended.

The UK Ambulance Services respond annually to nearly four million emergency calls, which place the responding emergency ambulance crews under increasing pressure to deliver high quality service and meet the expectations of the public as expressed in the Patients Charter.¹⁻³

Although the speed of response may be crucial to clinical outcomes in certain cases, for example, in ventricular fibrillation or airway obstruction and serious blood loss, responding to all emergency calls with the same rigour by the ambulance service is wasteful and creates unnecessary risk and stress both to crews and the public alike.⁴⁻⁶ The risk of road traffic accidents is associated with the increased speed of a vehicle, and this phenomenon equally applies to responding emergency vehicles.⁷⁻⁸ Similarly flashing blue lights and the sound of sirens, which are frequently used to alert the public to the need for free passage of the approaching emergency vehicle, may become intimidating in certain circumstances.⁷⁻⁹

It has been estimated that up to 12 000 accidents involving ambulances using lights and sirens occur annually in the United States and Canada. Additionally adverse effects such as inconvenience, stress, and effects to third parties have also been identified.¹⁰ However, no national data relating to accidents attributable to emergency ambulance responses could be identified in the United Kingdom. Interestingly, the Metropolitan Police in London have started to collect data relating accidents involving their emergency response vehicles with the urgency of the emergency call.¹¹⁻¹² Consequently this research seeks to provide data revealing inconvenience, risk, and adverse reaction that the general public may be subjected to by ambulances responding to emergency calls.

METHODS

The population of this study consisted of all male and female users of the public highway aged 11 years or older in Stafford-

shire. A survey approach using a structured questionnaire was used to collect information on the views and experiences of road users with ambulances responding to emergencies. A randomised pilot postal of 200 residences resulted in a poor response. Consequently a quota sample of 200 residences was taken producing a return of 67%. All information was kept confidential and anonymous. The research proposal was submitted to Coventry University Ethics Committee, who approved the study. Advice and guidance was obtained from senior officials of Staffordshire Ambulance Service and Staffordshire Police. In addition operational ambulance staff were consulted in regard to the contents of the questionnaire and asked to help with the pilot study.

The layout of the questionnaire was based on the format used for the Staffordshire Citizens Survey.¹³ It was designed to provide information on demographics such as age, sex, and the area of residence, on details of incidents between emergency vehicles and the public, on road users' ability to identify the approaching emergency vehicle, on necessary avoiding procedures, and on possible third party effects. An information sheet and guidelines to respondents were included with the questionnaire.

Responses to all 32 questions were numbered in the same format and analysed using SPSS for Windows.¹⁴ The results were presented in graphs and the non-parametric χ^2 association test used to determine the level of significance ($p < 0.05$).

RESULTS

The members of the public who returned their completed questionnaires were both men and women in roughly equal proportions (53% and 47% respectively). Their ages ranged from 21 to 61 and over. Half of the respondents were aged

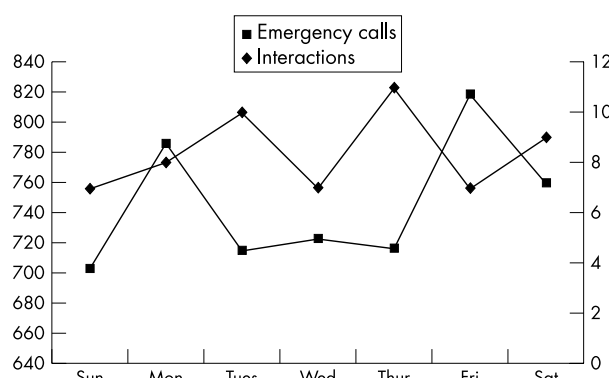


Figure 1 Emergency ambulance responses and public interactions on each weekday.

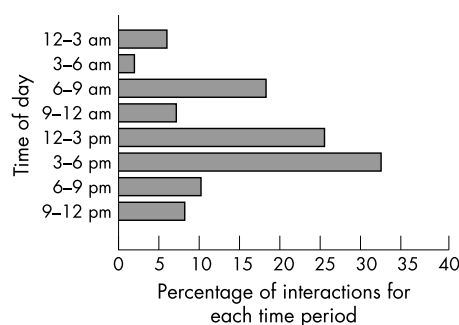


Figure 2 Occurrence (%) of events at different times of the day.

21–40 years, more than one third were between 41 and 60 years (38%), while the older adults made only 12% of the sample. Ninety two per cent of the respondents lived within Staffordshire, where the large majority of interactions (78%) between public road users and emergency ambulances of the Staffordshire Ambulance Service took place. The remaining 8% of participants lived in the West Midlands or Derbyshire. A small number of incidents were reported with other ambulance services or with the fire and police vehicles.

More than 42% of reported interactions in this survey occurred in the three months before the time of data collection. Furthermore, 21% of these events that have taken place in a three month period were recalled in less than one month thus falling well within the period of reliable memory recall.¹⁵

On closer examination it became apparent that the frequency of reported untoward events peaked on Thursday and was the lowest on Sunday (fig 1). Interestingly this was not reflected in the daily requests for emergency ambulance responses.¹⁶

A significantly higher number of interactions between the emergency ambulance and the public occurred between noon and midnight when compared with the equal period from the midnight to midday. Figure 2 shows the percentage of interactions over eight three-hour periods of the day, indicating the peak of activity at 3–6 pm.

The interactions occurred on six different categories of road—that is, motorway, dual carriageway, single lane A road, B road, C road, and unclassified byroads and country lanes. The seventh category included footpath, pedestrian crossing, and pavement. Table 1 shows the number of reported interactions on different categories of roads, the highest number being reported on A roads. However, when adjusted to the total mileage of each road type,¹⁷ it was found that dual carriageways produced most interactions per 1000 miles.

Public road users included car, bus, lorry, and van drivers. Motorcycle, bicycle, horse riders, and pedestrians were also included. Three quarters of the interactions between the emergency ambulance and the public were with car drivers, of whom 41% happened to be within a line of traffic. In 48% of cases respondents were moving at a speed of 21–30 mph, while 19% were moving faster than 30 mph. Interestingly 51% of all interactions with emergency ambulances occurred to road users who were not in the flow of traffic.

The ease of identification by the public of the approaching emergency vehicle was influenced by a number of factors such as speed, distance, and warning devices. In 26% of interactions examined the respondents reported being stationary. When the participants were asked to estimate the distance at which they were first able to identify the approaching emergency ambulance, 72% reported that they could detect the vehicle at distances in excess of 50 metres, while the remaining 28% of respondents spotted the vehicle at distances less than 50 metres. In 30% of interactions between the emergency ambulance service and the public the respondents reported that they failed to notice the vehicle warning lights, while 25% of the participants failed to hear the horns or sirens. More than a half of the participants, who could not see the warning lights, were not able to hear the horns.

To give free passage to the emergency vehicle, 61% of respondents were required to move their position on the road. Most members of the public (73%) found this a simple manoeuvre, while one quarter of the participants considered it to be difficult. During the avoiding actions 23% of the respondents reported that they were required to negotiate an obstacle. In addition to these manoeuvres, 20% of respondents were required to reverse or retract from their chosen course. In one third (32%) of the interactions between the emergency ambulance and the respondent, the actions taken to facilitate a free passage for the emergency vehicle resulted in a third party being affected ($p < 0.005$).

A large majority of respondents (91%) reported that they believed they acted in a controlled manner during the interactions with the emergency vehicle. Furthermore, 68% of the

Table 1 Public interactions with ambulances on emergency calls identified to road classification in Staffordshire

Road classification*	Interaction (n)	Interaction (%)	Road length (miles)†	Interactions/1000 miles
Motorway	2	1.9	72	28
Dual carriage	14	13.3	145	311
A road	34	32.4	754	45
B road	19	18.1	337	27
C road	17	16.2	1357	13
Unclassified road	8	7.6	3301	2
Pedestrian crossing, paths, pavements	11	10.5		
Total	105	100		

*Ten questionnaires did not specify the type of road. †Figures do not include Stoke on Trent.

respondents did not find the interaction demanding or stressful. The participants' perception of stress was significantly associated with their behaviour during the interactions ($p < 0.002$).

DISCUSSION

The results of this local survey suggest that a large section of the adult population in Staffordshire recalled interactions with emergency ambulances, which may be identified by flashing blue lights, sirens, and the white livery with a green chequered band at the midline of the vehicle. A number of vehicles have an additional yellow and red chevron at the rear. It has been suggested that more strongly contrasting colours would help the public to identify emergency vehicles and that yellow-green hues would offer the greatest benefit if surrounded by a complementary colour.^{18,19} The limited effectiveness in alerting public road users of the approaching ambulance in this study reflects the findings of others.⁸

Mainly because of tradition rather than scientific evidence of the effectiveness of a blue light response, ambulances respond to emergency calls, driving fast using horns and sirens along with flashing lights. Research carried out within the London Ambulance Service indicated that only 57% of calls had a valid clinical reason for calling an ambulance.^{20,21} However, there are life threatening situations such as ventricular fibrillation attributable to myocardial infarct, which require a fast response. It has been recognised in North America, and now in the United Kingdom, that faster than eight minute response times are required to be effective in these acute situations. To improve survival automatic external defibrillators have been introduced and located in public places.⁴

It would be useful to consider further the evidence for the use of blue lights and sirens, which after all are intended to alert the public to the need for free passage and not to demand it.^{22,23} Research has indicated that an average of 3.02 minutes could be saved when responding to an emergency call in an urban environment on lights and sirens, and that this saving could be clinically relevant.^{2,3} On the other hand the rationale for the use of lights and sirens may be contradicted by ambiguous mobilisation and activation standards, which may by inherent practice make ineffective any implied relevance to clinical outcomes.⁴ It has been suggested that if more rigour were applied to mobilisation, it would be reflected in the overall job cycle time being more efficient and effective than the use of lights and sirens.²⁴ It should be noted that the Staffordshire Ambulance Service already applies strict control over mobilisation. Similarly it has been suggested that the use of a medical protocol system would permit a reduction in the use of lights and sirens without adversely affecting the transport of patients to hospital.⁹ However, triaging the critically ill or injured on receipt of the emergency call by despatch protocol systems does not gain universal approval, as it is not considered sensitive enough at present.^{3,25}

Emergency ambulance calls are generally responded to with the use of lights and sirens, and our findings suggest that in most cases this was the practice. However, a considerable fraction of road users failed to see the blue lights or hear the sirens. Furthermore, the rationale for the use of emergency devices was not clear, as the use of sirens was not always in unison with the lights.²²

It is possible that the emergency warning devices may cause stress in circumstances where the frequency of flashing lights is stroboscopic or the intensity of sound from the sirens/horns is intimidating.²² In fact it is well reported, that some road users exhibit signs of instantaneous panic reactions when approached by the emergency vehicle using lights and sirens.^{22,26} Therefore it is important to examine further the possible association of stress caused by lights and sirens with avoidance manoeuvres and third party effects. Both the

psychological effects and inconvenience caused to the public need to be weighed against clinical priorities in the development of strategies for the deployment of the emergency ambulance.

At present it is difficult to find information on third party interactions and wake effect collisions.¹⁰⁻¹² In North America studies into third party interactions recorded by the fire department found that there were many more third party collisions than direct emergency vehicle collisions producing a ratio of 4.25 to 1.¹¹ Our studies in Staffordshire indicate that one third of the respondents who were required to take avoidance action of reversing/retracting to permit free passage of the emergency vehicle became involved with a third party.

Although members of the public needed to change road position and reverse their vehicles, sometimes in difficult circumstances and with obstacles to negotiate, they were largely satisfied with the way the emergency crews handled the situation. This positive outcome was the case even though it was felt that some of the adverse effects during the interactions could have been avoided. Although most of the respondents were not affected psychologically by the passage of the emergency ambulance, a third of the public road users felt that a demanding and stressful environment had been created. Wide use of audible warning devices was revealed, which may be linked to the respondents perception of how the interaction was managed by the emergency crew.²⁷

Conclusions

This study indicates that the occurrence of emergency vehicle interactions with adult road users in Staffordshire is the highest on Thursday and the lowest on Sunday. Surprisingly this frequency pattern does not correspond with the rate of emergency calls. Without further work it is not possible to conclude whether the observed frequencies were associated with the local density of traffic on different days of the week. Most of the untoward incidents were reported to have taken place on A roads, but when adjusted to the total mileage of different types of roads in Staffordshire, it was found that the dual carriageway was the most common site of interactions per 1000 miles of road.

Our findings suggest that a significant number of interactions created direct and indirect inconvenience, and potential danger. Some road users failed to observe the emergency lights and sirens, and more than 50% of the respondents were required to move their position to permit the passage of emergency ambulances. A third of these interactions resulted in a wake effect thus placing an increasing number of third party road users at risk.

Only one quarter of the respondents found the interactions with emergency ambulances difficult to handle, and most members of the public felt that they had acted in a controlled manner in these situations. Conversely it was found that about one third of the participants found the experience stressful. In addition the use of time to incident as the performance standard for ambulance services will continue to influence the possibility of harmful interactions with the public road user and the ambulance service.

Following from the above findings, it is suggested that there is need for further research in the effectiveness and appropriate use of ambulance identification and warning devices. This further research should include the clinical validity of the emergency case being attended with the lights and sirens response.

ACKNOWLEDGEMENTS

The authors are grateful to all the participants, and the assistance given by staff of Staffordshire Ambulance Service.

Contributors

Geoff Saunders conducted this research as part of his BSc (Hon) degree at Coventry University. He designed the approach and

technique used and completed the data collection and analysis. Anna Gough supervised the project and contributed jointly to the writing of this article. Dr Anna Gough acts as a guarantor.

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Authors' affiliations

G Saunders, Staffordshire Ambulance Service NHS Trust, Stafford, UK
A Gough, Injury Prevention Research Unit, Coventry University, Coventry, UK

Funding: none.

Conflicts of interest: none.

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